DEPARTMENT OF COMMERCE

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SCOTT TURNER, DIRECTOR

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MINING AND TECHNOLOGY GRADUATES AND THEIR PROBLEMS

BY

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MINING AND TECHNOLOGY GRADUATES AND THEIR PROBLEMS[1]

By Scott Turner[2]

Since my whole life has been spent in the mining business, I naturally tend to address my remarks particularly to the newly-graduated mining and metallurgical engineers among you. To a certain extent, all forms of engineering principles are involved in the training of the mining engineer, and most sorts of engineering are certainly utilized by him, so that every one of this graduating class is concerned with the field I propose to discuss.

The fact that, beginning with to-day, you will always be styled engineers, indicates that you have passed successfully through preparatory school, and have survived the hard grind of the technical college. One object of your training here has been to instruct you in accurate, close, and clear thinking. Your minds have been taught to act directly, calmly, and always to the point. By now, you should know how to get facts, look far, and think through. You are supposed to be willing to recognize and adopt sound engineering principles and practices, in so far as they are known to you, and to furnish character, ability, and devotion to your calling.

Some of you may have had a general college course before coming here to specialize in engineering. Where that has been possible, I hope it is the case, since a liberal educational course tends to make the alumnus more flexible and adaptable than the purely scientific graduate. The broader education enables one to change, with less serious loss, from one job to another; ready adaptability is a great asset; the engineer should be capable of much more than a single special task. The necessary preliminary training for a professional occupation is intellectual in character, involving knowledge, and to some extent learning, as distinguished from mere skill. The well-balanced engineer is expected to embody a happy combination of theory and fact, of pure science and material reality; experience shows that he is apt to give a good account of himself, once he gets the chance.

For the long pull, the importance of unquestioned integrity can not be overemphasized. Leaders of big business sometimes have need for a man as agile and unscrupulous as a cat on a back fence; on occasion, they may have to employ brilliant, smart, spectacular, and crafty people, but when the special purposes for which such men are hired have been accomplished, they are no longer wanted. Given natural health, intelligence, ability, and adequate training, probably the characteristics most admired in the young employee are steadiness, dependability, and loyalty. The last is the best. If you can not be simple, direct, and faithful in your dealings with your administrative superiors, no one will want you for long.

I believe these points are of primary importance to the young engineer. Your groundwork must be right before you can get far. These personal characteristics are what eventually determine your relations with men and affairs. They are vital in the human engineering which may be a large part of your work.

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[2] - Director, U. S Bureau of Mines.

There have been many graduating classes, in many colleges. New thoughts and words appropriate to such occasions are difficult to discover, and perhaps could not be expected; the purpose may be best served by repeating and emphasizing some of the old ideas, which to you may resemble new.

No graduation address would be complete unless it contained the trite statement that leaving school does not mark the end of the education of the young engineer. This is so true, and so important, that it may well be said on every occasion of this kind. Your studies are only beginning. I hope that you already know how patiently to observe and classify facts, and that you sense the value of inference, verification, and conclusion. Doubtless you have all done some original piece of investigative work, in preparing a thesis or developing a theory, and you have already experienced the pleasure of actually unearthing some new bit of truth; you will have plenty of opportunities, and you will have further proof that this furnishes the keenest intellectual satisfaction the mind can know.

I presume you have thought about what attitude you will adopt toward your new environment outside of college halls, you have puzzled over the widening intellectual horizon that your studies have been bringing you, you are vaguely aware of the deepening faith that should come with years, that already you are struggling with the persistent problems of modern life which press upon you for solution, and that what you now would most like to know is about conditions of everyday existence, and how you can deal with its fundamental problems.

During the past decade, a great deal has been said about the accomplishments of science and engineering in the last half century. It is generally recognized that engineering is an occupation in which the amount of financial return is not the accepted standard for reckoning success. Rather, excellence of performance, advance of the profession, and service to the community are better measures. Engineering is a calling which should be pursued largely for others and not merely for one's self.

In the mining business, which on the whole is run pretty largely for the purpose of making money, similar tests might be applied in determining the amount of success attained, although the earning of a profit is here more than an incident to success, because the continued absence of profit spells failure. On the other hand, while loss spells failure, large profits do not connote success.

No one is more deeply concerned with our present economic plight than the young graduate. Even in good times, it is difficult enough to get started in the practice of your profession. Just now it may seem almost impossible. Probably no one is more puzzled than the novitiate as to the causes of our present economic situation. Although all sorts of theories are advanced, of course no one really knows. It is easy to say that we came to our high estate by highways which were tried and tested, but that now we are detouring into new and little-traveled byways, some not even paved with good intentions. It is not so easy to point out the right road, or to show how to follow it. Recently I heard an eloquent lawyer and statesman deliver an address in the course of which he said that what we needed was to go back to work; hard work was the only cure. The following night I heard a great educator, in a thoughtful speech, say that the trouble with us was that we did too much work; that more leisure should be indulged in, and that the schools and colleges must instruct the students in the cultivation and employment of leisure. Which are we to believe?

When in doubt, we are apt to fall back on first principles as taught us by our parents. I was brought up to believe in hard work, and I know what a comfort diligence and activity are in time of worry and stress. For the lack of better advice, let us stick to old doctrines, and say that salvation lies in earnest and prolonged labor and effort, in making stepping stones of obstacles. As to training in the schools, which would be better off during business depression, when competition is the most ruthless, the man who as a student had been trained to pleasant leisure, or he who had been trained to disciplined hard work? I do not deny the value of culture, or of a certain amount of intellectual detachment for which leisure is necessary, but hard work does not exclude these.

Perhaps you can do no better than to conclude that the present, universal, sad state of economic and industrial affairs is directly or indirectly chargeable to the World War. No such wholesale destruction of life, material, and property can be carried out, with attendant overexpansion, without serious and far-reaching results. Why not just decide that we are economically sick, from excesses of various sorts, and admit that the best treatment is calm, quiet, and the passage of time, giving nature an opportunity to do as she always does, - gradually build up resistance to the malady until it is eventually overcome in a perhaps unpredictable and unexplainable but none the less natural way?

Many educators feel that students no longer believe in anything; not in the wisdom of their parents, the knowledge of their teachers, the ability of business leaders, nor the efficacy of government officials. If you feel you are losing faith in your country, hark back to the principles of industrial democracy and social justice on which our Government is founded. It may be true that modern democracies are so deficient in imagination that it is utterly hopeless, by an appeal to their intelligence, to make them visualize the logical, inescapable consequences of their course; but in analyzing the reports and rumors which abound at a time like this, you must remember that in a democracy no department of government can long escape criticism. While secretaries of departments, directors of bureaus, or the temporary incumbents of similar governmental organizations are generally exempt from personal attack, the divisions of our government themselves have been subject to continuous assault from the beginning of the Republic, often from a small minority of selfish or cantankerous people.

Perhaps faith will only come again by starting anew, living simpler, progressing slower, studying more understandingly, and working more earnestly. You, at least, will live to see the world extricate itself from the present dilemma; some of us, of one generation earlier, may not last long enough to see this economic riddle completely solved. At least, you are living at an interesting period in the world's history, and you should endeavor, at the start, to orient yourselves properly to the new order of things.

The foregoing remarks deal largely with engineering in general. Now let me say something about mining engineering. Perhaps I should briefly review the commodity field, dealing separately with each of a few common metals. Let me first suggest to you a particularly fascinating field for work and study. It is that occupied by the metal gold.

Some of you will be middle-aged, and perhaps at your technical best, when the question comes prominently to the fore as to adequacy of the then gold production to maintain monetary stocks as a basis for credit. Due to anticipated marked decrease in Rand production about 15 years hence, some time during the 1940's there may be a fairly sharp fall in annual world production, unless new and unexploited sources of supply are discovered and developed. When the increasing discrepancy between gold stocks and credits becomes more generally recognized, there will be a call for men best fitted to deal with this problem. Some of you may be ready, when that time comes.

A mining engineer should ground himself in the fundamentals of economics, banking, finance, and history if he desires to deal with such a question. If man can not get more gold, he may help in devising ways of using what we have more effectively. Some authorities insist that our credit structure must contract, which, in the absence of a great outpouring of new gold, means constantly falling prices -- hard times; I do not hold this view, and perhaps it will be one of you who will show the way to further safe credit-expansion in general support of my inference that gold has not yet been utilized fully. In an article published the end of last year I stated that -

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> Although there are many who believe that in view of the existing machinery of credit the connection between the amount of gold and the level of prices is no longer direct or immediate, and there are others who even advocate the divorce of gold from its immemorial function in exchange, nevertheless there appears to be reason for supposing that gold will continue indefinitely to be the one item in monetary systems by which their other elements will be evaluated.

It is easy to point to faults in the gold standard, but it remains the best we have, or have ever had. Great Britain, in her crisis, as an emergency measure had to abandon it; the Scandinavian kingdoms did likewise; also a score of other countries have temporarily, and for pressing economic reasons, quit the gold basis. I predict that most of them will return when they can. At present the only commercially-important gold-standard countries in the world are the United States, France, Belgium, the Netherlands, and Switzerland.

It seems unlikely that the world-wide sharp fall in prices can be charged to lack of monetary gold. A result so caused would be gradual, not abrupt. It is equally in error to state that the United States in her greediness has deliberately concentrated here so much gold as to handicap the other nations. Though we now hold about 35 per cent of the world's gold, amounting to about $4,300,000,000, it has accumulated here in spite of ourselves, to balance trade, to pay off old debts, to purchase commodities, and for safe storage. Moreover, the industries of this nation are so great and productive that our gold stock should actually be large; when judged on this basis, it is by no means as excessive as many represent it to be.

Since I began my professional career, I have seen the United States gold poduction go from about $80,000,000 a year in 1904, to an all-time maximum of $99,714,800 in 1915, subsequent to which it has fallen quite steadily until, in 1930, it was only $43,419,000. See what you can do about this during the coming 10 or 15 years. The next cycle is about due; the gold boom of 1348-1852, was followed by that of 1893-1908; so it would be fine if you young fellows could bring about a third upward swing, which seems to be apt to culminate about the time you will be turning 40, and thus just getting into your best professional stride.

If you can't find more gold in your own country, or develop cheaper and better methods of mining and milling so as to make it possible to mine profitably some of our lower-grade ores, then busy yourselves in some other country and help swell the world total for the benefit of every one. You doubtless know that the benefits of metal-utilization largely exceed those of metal production. It is, therefore, a striking fact that production of gold, and of many other metals besides, anywhere in the world, is beneficial to the United States as the greatest industrial nation and the most outstanding consumer as well as producer of metals. The countries that know best how to utilize metals profit most from their possession and can therefore pay more for them than others. Hence the world first supplies their demands, and, according to their financial ability, other countries compete for the balance that remains.

Here is a good chance for some of the best of you to do useful work. In the United States, our money is backed by gold to a minimum of 40 per cent of its face value. This, however, is only the first step in the pyramiding of credit on gold. The national debt alone represents a credit, granted to our Government by investors, of over three times our supply of monetary gold. Yet, the national debt is small compared with the total of State, municipal, and private debts. Since the curve representing credits is rising at a much more rapid rate than that indicating stocks of gold, at what point will this divergence become a real menace? Thus far, gold has been able to carry the credit-load here in our own country, but within the past year we have seen half the world swept from the gold standard. Is our hoard of gold and our way of managing it such that the United States gold dollar will always be impregnable? It is a theoretical question, yet a vitally important one.

Although I have first called your attention to gold, since you are here in a copper-mining region, your thoughts may turn first to copper mining, particularly in Michigan. You probably know the history of this region, its production and accomplishments, and the present state of affairs in the mines of Keweenaw Point. However, I shall summarize some of the outstanding facts. The first commercial mining, by white people, aside from a few tons found at Copper Harbor in 1844, commenced in 1845 at a point 2 miles northeast of the Ojibway mine, in what is still known as the Cliff mine. Miners, in clearing away the talus near the base of a cliff, discovered copper that led them to explore within the hill, where a 50-ton mass was struck. Subsequently, masses weighing 500 tons were discovered. The first year of recorded production for the Lake Superior district was 1845, when the total was 26,880 pounds. The year of maximum production was 1916, when the all-time record of 269,794,531 pounds, or 134,897 tons, was attained. Though production has declined since then, to the end of 1930 these mines had produced 8,382,282,360 pounds, or 4,191,141 tons of metallic copper, and the mining companies have paid $327,807,147 in dividends. Since 288,627,032 tons of ore have been treated, it is apparent that the average yield has been 29.04 pounds of copper per ton of ore.

Copper was mined at an early date in central Africa. However, it may be that the first important center of production was Cyprus, after which came Spain, Germany, Sweden, England, and Chile. From Chile the point of maximum production jumped to the United States in 1883. In this country, Michigan was at first the center of production. Thence the center moved to Montana in 1887; and in 1907 to Arizona, where it now rests. We already see signs of the passing of American copper supremacy, and it may be that within the next generation it will return to central Africa, thus completing the cycle, in about 4,000 years, by a path that embraces the basin of the Atlantic Ocean.

Northern Michigan has had a long and honorable career as a copper producer. Good mines die hard, but I presume that informed people have already warned you of the havoc low copper prices have produced here. The mines are old, and deep, the grade is relatively low; even though costs be still further lowered, and present selling price be doubled, it must be apparent to all that for the near future this region offers but limited promise to any considerable group of young mining graduates.

Your nearest neighbors are the iron mines, included within the borders of Michigan, Minnesota, and Wisconsin. Here your chances appear better, since known or probable reserves of present-grade ores are adequate for at least the most active period of your lives. You may be sure that iron mining on a large scale will be carried on in the Lake Superior region until you are ready to quit or are retired as too old to work.

Commercial iron mining started in Michigan about 1845. This state was the biggest producer until 1902, when Minnesota took the lead, which she now holds. Records indicate that Michigan has produced about 508,000,000 tons of ore to the end of 1931, valued at the mines at approximately $3,000,000,000. Minnesota appears to have produced in all about 987,000,000 tons with an at-the-mine value of about $5,500,000,000. Wisconsin makes a poor third, with all-time figures showing about 37,000,000 tons.

Most estimators concede that the Lake Superior ore reserves contain at least 1½ billion tons. This is good for 25 years anyhow, and some think that the region has 50 years' supply of ore of the grade now being mined. The tax commissions', and other figures, pretty clearly indicate that the minimum of merchantable ore of current commercial grade existing in the Lake Superior region, is distributed about as follows:

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Minnesota..........	1,250,000,000
Michigan.	175,000,000
Wisconsin.... ...	25,000,000
	1,450,000,000

Of course, lower-grade ores exist in much larger quantities.

So, as I said before, this iron-ore region will last at least as long as you will, and it may be that you will want to do your life's work in this neighborhood.

Among the common metals, lead appears to have a promising outlook for the future. Although there has been some increase in world reserves during the past decade, the total available supply is not excessive. Under normal conditions, the production of the United States is not sufficient for the demand, so that we must import the difference from abroad. Ten to twenty years from now, our domestic lead supply may have reached a critical stage, and engineering ingenuity will be called on to increase efficiency and reduce costs so that our lead resources may be utilized to the utmost. Here is a field that should appeal to a young engineer. Opportunities for service in this industry would seem to be in the field of exploration and in increasing efficiency in the mining and milling of lead ores. Extraction in lead smelting methods has reached a point approximating perfection; however, there is still a chance for improvement in the cost of the operation.

Lead mining is one of our oldest mineral industries. According to authentic records, production began at Falling Creek, Va., in 1621. As early as 1650, lead was being mined by the English colonists in New England and by Jesuit missionaries in Arizona. Prior to the Civil War, production of lead was confined largely to the Mississippi Valley and eastern States. Our present huge production really had its beginning in 1869. In that year the famous disseminated deposits of southeastern Missouri were discovered, and the first transcontinental railway was completed, the latter permitting rapid development of the rich lead deposits of the West.

The center of production soon shifted to the western States. Colorado's output increased from a few tons in 1873 to 82,000 tons at the beginning of the twentieth century; Utah, which had produced small quantities of lead as far back as the early fifties, increased its output to nearly 50,000 tons in 1900; Idaho, after the discovery of the great deposits of the Coeur d'Alene district in 1885, raised its output to 85,000 tons in 1900. In 1908, Missouri became the leading producer of lead, a position which she still holds.

It seems likely that the lead industry will provide an opportunity for the employment of limited numbers of young engineers as soon as industrial conditions return to a normal level, and that alertness, aggressiveness, and imagination will be amply rewarded. The best prospects appear to be in the western States, where operations are on a smaller scale and where a young engineer has a wider field in which to display ability.

The zinc industry may offer a chance for those of you who are interested in metallurgy, for, in spite of great improvement during the past decade, the recovery of zinc from its ores is more wasteful and costly than the recovery of other common nonferrous metals. Recent developments indicate the need for improved extraction and for other ways of reducing the cost of producing zinc. During the past decade, there has been a substantial increase in the world's zinc reserves, particularly in foreign countries. Many of the new discoveries have been high-grade orebodies or deposits large enough to permit the use of large-scale low-cost methods. This has resulted in expansion of producing capacity and lowering of the average cost of production. The market for zinc is such that an equivalent expansion of consumption can hardly be expected. For these reasons, it is believed that in the future the price of zinc will be maintained at relatively lower levels than heretofore. If this comes to pass, our domestic producers, if they are to survive, will have to meet the new conditions with improved technology. I have no doubt that some of your generation will contribute to the solution of this problem.

Zinc mining is perhaps the least centralized of any of our metal-mining activities. Unlike gold, silver, copper, and lead, the bulk of the production comes from the central, southern, and eastern States. The principal zinc-producing region is the Joplin district, at the junction of the three States Missouri, Oklahoma, and Kansas. The reserves of this district are still large, and with favorable prices, undoubtedly Joplin will retain its rank as the leading zinc producer for many years to come. Upon resumption of normal production, this district should provide employment for some young engineers. The substitution of large-scale-milling units for small plants has been making progress recently, and this should create a demand for more technical supervision, in order that the full efficiency of large-scale operation can be achieved.

Next in importance in zinc-yield is the State of New Jersey, where the famous mine at Franklin Furnace has been producing steadily since the middle of the nineteenth century. Another eastern State, New York, has recently become a contributor to the domestic zinc supply, and will probably be an even more important source in the future. In the South, Tennessee and Virginia have become notable producers in recent years and their outputs are likely to expand. Your neighboring State, Wisconsin, has been a source of zinc since the beginning of the century, but there has been some decline recently and it is doubtful if former production-levels will be reached again in the immediate future. Many of our western States, particularly Montana, Utah, Idaho, New Mexico, and Colorado, produce large quantities of zinc.

The reserves of zinc in this country apparently are ample for several years to come. Opportunity for useful service, therefore, would seem to be in the field of lowering the costs of production and in widening the market for zinc, rather than in seeking and developing new deposits. Those of you who enter the zinc industry may be assured of the chance for long and interesting employment.

The beginnings of the silver-mining industry in the United States are associated with two great events in mining and metallurgical engineering -- the introduction of square-set timbering for stoping large deposits, and the invention of the pan-amalgamation process for treating silver ores. The silver-mining industry has grown tremendously since those early days on the Comstock. It reached an all-time peak of nearly 75,000,000 ounces in 1915. Since then, production has declined, and in 1931 only 31,000,000 ounces were produced. This decline is associated with another more significant change in the silver industry; silver has become a by-product of the mining of copper, lead, gold, and zinc. There is little opportunity to produce silver alone, but virtually every engineer engaged in winning the common metals of the nonferrous group in the United States finds himself a producer of silver. Moreover, the revenue derived from by-product silver frequently represents the margin of profit for the operation.

One of the principal reasons for the decline and virtual disappearance in the United States of the straight-silver mines has been the fall in silver's price. This price-drop has resulted from the progressive demonetization of silver throughout the world, since Great Britain made the first move in that direction at the close of the Napoleonic Wars over a century ago. Silver needs a new use to replace its waning popularity as money.

The discovery of a new outlet for silver comparable with the monetary requirements of the past would raise the price of silver to an extent that would revive not only the silver-mining industry of the West, but would inject new life into hundreds of by-product silver mines producing chiefly copper, lead, gold, and zinc. One of you, if successful in this field, might thus become a benefactor to each of your classmates, as well as to the mining industry in general, and to the nation.

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In summarizing the prospects of employment in the metal-mining industry during the next 20 years, it appears that gold mining presents the most promising field. If relatively low price-levels continue, the increasing trend of production witnessed in 1930 and 1931 may be expected to continue. This industry has probably supported more engineers than any other branch of mining, as gold mines are more numerous than any other kind.

Out of a total of 2,262 deep nonferrous metal mines operating in the United States in 1928, gold was the principal product in 932 of them. In addition, there were 1,202 placer-mining operations. So there were 2,134 gold producers out of a total of 3,464 nonferrous metal mines, including placers. Lead was the principal product in 479 mines, silver in 333, zinc in 267, and copper in 251 mines. The number of iron mines operating in the United States in 1928 was 211.

Another factor which will tend to make gold mining attractive to engineers is the ever-increasing demand for its product. It is inevitable that the gold supply must be maintained if not increased during our lifetimes, and it seems that this can only be accomplished by constantly improving methods of extraction, both mining and metallurgical, so that lower and lower grades of ores can be worked profitably. This is one of the important responsibilities of the mining engineer to society.

Copper, lead, zinc, and iron mining should require large numbers of engneers during the next 20 years, as the problems that confront these industries, particularly in the United States, are such that they will yield only to careful scientific analysis.

From the geographical point of view, I see no reason why North America should not continue to be the most important source of metals during your lifetimes. It is possible that the relative importance of the United States will diminish, but it is certain that Mexico and Canada will compensate fully for any such decline. I have just pointed out some shifts in the geographical picture, such as the increase of copper production in Africa, and you must be aware of the larger gold production in Canada. Production of lead, zinc, and copper will probably be greatly increased in our neighboring countries of the North American continent, but this should be no hindrance, as American engineers and American methods are employed the world over. Our engineers have long been oriented to the idea of service, and they have shown no hesitation about going wherever there is a job to be done, regardless of whether it is in the research laboratories of our metropolitan areas or in the jungle seeking new deposits to satisfy man's desire for metals.

To the young engineer, I urge consideration of the broader aspects of the mineral industry. The mining man is no longer concerned solely with the problem of extracting ore and producing a metal ingot therefrom. For example, these are times when mining companies are becoming more and more interested in the marketing of their products, consequently the mining engineer and metallurgist has been called upon to explore the field of marketing. Research is being conducted on a large scale to find new uses for metals; likewise to improve the qualities of metals so that they may better serve the uses previously well-established. Recent developments in the chemical industry have resulted in the production of substitutes for metals; competition between the various metals increases day by day. I have no doubt that the training you have received at this institution has been broad enough that you are qualified to serve in this phase of engineering which offers opportunity for profitable service to the mineral industry.

These few references to fields of endeavor that may be open to the miners, metallurgists, geologists, and others among you, may suffice to stimulate your consideration of where and what you choose to work. While few people get what they want, still it is good to have an objective and to strive to make progress toward it. Having picked your field, or chance having given you an opportunity in a direction which you may be forced to follow, try to pause occasionally and apply certain tests to yourself, your work, and your relation to your profession and your fellow-men.

Remember that certain fundamentals are required of you before you can become good engineers in the broadest sense of the word. Are yo clean, earnest, unselfish, energetic, and intelligent enough to make your way, and ultimately take your place among the leaders of your profession? Examine yourselves; try to strengthen the places in your character that you know to be weak. Cultivate and emphasize sincerity, honesty, and loyalty; keep foremost in your minds the value of character and courage, honesty and high ambition, earnestness and pride.

You young engineers should consider that you are in the world for what you can put in it, rather than for what you can get out of it. The assumption is that you have chosen the engineering profession because you believe that through it you can make the largest contribution to the common good; to accomplish this, you must be prepared to furnish accuracy, promptness, and fidelity, and to accept responsibility.

The professional man, in addition to having a certain amount of culture, must be able, when the occasion demands, to be assertive, bold, and self-reliant. If he is ambitious, at the same time he should be high-minded and proud-spirited, with the capacity for studious reflection when leisure permits.

Do not be discouraged by your apparent inadequacy. A successful man once said of another: "I am glad to join in tribute to him; I have followed his career with great interest; he is a striking illustration of how much success can be achieved in life with a limited amount of ability."

Engineering has been defined as the method whereby man shapes nature to human uses, and harnesses natural forces to human wills. In all industrial engineering, to gain success one must help to bring about advances in methods and processes, improvement of products, or perfecting of organizations; the engineer should strive to reduce friction and waste, to improve working conditions and promote happiness of the workmen, and to establish and maintain the proper relations with customers and with the community. It is pretty well understood that the great failures in the engineering profession are chargeable to want of insight into human nature, rather than to any deficiency in mastery of materials. The older you get, the more you will realize that you must comprehend your men as well as you apprehend the qualities of your substances.

The graduates of Houghton have to measure up to a high standard of excellence set by their predecessors. The competence of Houghton men is traditional, and this should stimulate you to high endeavor. Preeminence may be attained by advancing the aims, ideals, and nature of engineering, through individual initiative, courage, and spirit. My last word to you is: Be faithful to your calling, and let no difficulties impair the fineness of your work.